

**Billing Code: 4910-60-P**

**DEPARTMENT OF TRANSPORTATION**

**Research and Special Programs Administration**

**Notification of the Susceptibility to Premature Brittle-like Cracking of Older Plastic Pipe.**

**AGENCY:** Research and Special Programs Administration (RSPA), DOT.

**ACTION:** Notice; issuance of advisory bulletin.

**SUMMARY:** RSPA is issuing this follow-up advisory bulletin to owners and operators of natural gas distribution systems to inform them of the susceptibility to premature brittle-like cracking of older plastic pipe and the voluntary efforts to collect and analyze data on plastic pipe performance. A Special Investigation Report issued by the National Transportation Safety Board (NTSB) described how plastic pipe installed in natural gas distribution systems from the 1960s through the early 1980s may be vulnerable to brittle-like cracking resulting in gas leakage and potential hazards to the public and property. On March 11, 1999, RSPA issued two advisory bulletins on this issue. The first bulletin reminded natural gas distribution system operators of the potential poor resistance to brittle-like cracking of certain polyethylene pipe manufactured by Century Utility Products, Inc. The second bulletin advised natural gas distribution system operators of the potential vulnerability of older plastic

pipe to brittle-like cracking.

**ADDRESS:** This document can be viewed on the Office of Pipeline Safety (OPS) home page at:

<http://ops.dot.gov>.

**FOR FURTHER INFORMATION CONTACT:** Gopala K. Vinjamuri, (202) 366-4503, or by email at [gopala.vinjamuri@rspa.dot.gov](mailto:gopala.vinjamuri@rspa.dot.gov).

## **SUPPLEMENTARY INFORMATION**

### **I. Background**

On April 23, 1998, NTSB issued a Special Investigation Report (NTSB/SIR-98/01), *Brittle-like Cracking in Plastic Pipe for Gas Service*, that describes how plastic pipe installed in natural gas distribution systems from the 1960s through the early 1980s may be vulnerable to brittle-like cracking resulting in gas leakage and potential hazards to the public and property. An NTSB survey of the accident history of plastic pipe suggested that the material may be susceptible to premature brittle-like cracking under conditions of local stress intensification because of improper joining or installation procedures. Hundreds of thousands of miles of plastic pipe have been installed, with a significant amount installed prior to the early-1980s. NTSB believes any vulnerability of this material to premature cracking could represent a potentially serious hazard to public safety. Copies of this report may be obtained by calling NTSB's Public Inquiry Office at 202-314-6551.

RSPA has already issued two advisory bulletins on this issue. The first advisory bulletin, ADB-99-01, which was published in the Federal Register on March 11, 1999 (47 FR 12211), reminded natural gas distribution system operators of the potential poor resistance to brittle-like cracking of certain polyethylene pipe manufactured by Century Utility Products, Inc. The second advisory bulletin, ADB-99-02, also published in the Federal Register on March 11, 1999 (47 FR 12212), advised natural gas distribution system operators of the potential brittle-like cracking vulnerability of plastic pipe installed between the 1960s and early 1980s.

The phenomenon of brittle-like cracking in plastic pipe as described in the NTSB report and generally understood within the plastic pipeline industry relates to a part-through crack initiation in the pipe wall followed by stable crack growth at stress levels much lower than the stress required for yielding, resulting in a very tight slit-like openings and gas leaks. Although significant cracking may occur at points of stress concentration and near improperly designed or installed fittings, small brittle-like cracks may be difficult to detect until a significant amount of gas leaks out of the pipe, and potentially migrates into an enclosed space such as a basement. Premature brittle-like cracking requires relatively high localized stress intensification that may be a result from geometrical discontinuities, excessive bending, improper installation of fittings, and dents and gouges. Because this failure mode exhibits no evidence of gross yielding at the failure location, the term brittle-like cracking is used. This phenomenon is different from brittle fracture, in which the pipe failure causes in fragmentation of the pipe.

The NTSB report suggests that the combination of more durable plastic pipe materials and more

realistic strength testing has improved the reliability of estimates of the long-term hydrostatic strength of modern plastic pipe and fittings. The report also documents that older polyethylene pipe, manufactured from the 1960s through the early 1980s, may fail at lower stresses and after less time than was originally projected. NTSB alleges that past standards used to rate the long-term strength of plastic pipe may have overrated the strength and resistance to brittle-like cracking of much of the plastic pipe manufactured and used for gas service from the 1960s through the early 1980s.

In 1998, NTSB made several recommendations to trade organizations and to RSPA on the need for a better understanding of the susceptibility of plastic pipe to brittle-like cracking. This advisory bulletin responds to one of the NTSB recommendations. It is that RSPA "[d]etermine the extent of the susceptibility to premature brittle-like cracking of older plastic piping (beyond that marketed by Century Utilities Products Inc.) that remains in use for gas service nationwide. Inform gas system operators of the findings and require them to closely monitor the performance of the older plastic piping and to identify and replace, in a timely manner, any of the piping that indicates poor performance based on such evaluation factors as installation, operating, and environmental conditions; piping failure characteristics; and leak history."

In order to obtain the most complete information on the extent of the susceptibility to premature brittle-like cracking of older plastic pipe, a meeting was convened in May 1999 with all the stakeholders to determine how information on older plastic pipe could be assembled. The meeting included representatives of the American Gas Association (AGA), the American Public Gas Association

(APGA), the Gas Research Institute (GRI) (now the Gas Technology Institute), the Midwest Energy Association (MEA), and the Plastic Pipe Institute (PPI).

As a result of the May 1999 meeting, the Joint Government-Industry Plastic Pipe Study Committee was formed to address the recommendations of the NTSB Special Investigation Report. The committee held three separate meetings to prepare a draft response to the NTSB recommendations and a draft industry notification of brittle-like cracking problems, the subject of this advisory bulletin. The committee membership consisted of a representative from OPS, a gas distribution operator from AGA, and the Transportation Safety Institute. Meetings were facilitated by General Physics Corporation, Columbia, MD. One of the committee findings was that there is a lack of data available from the industry to completely identify older plastic pipe that is still in service and may be susceptible to brittle-like cracking.

This finding led to the formation of the Plastic Pipe Database Committee (PPDC) to develop a process for gathering data on future plastic pipe failures with involvement from the states, which have assumed the authority from OPS over gas distribution systems, where most of the plastic pipe is installed. The PPDC is comprised of representatives from Federal and State regulatory agencies and from the natural gas and plastic pipe industries. Members include AGA, APGA, PPI, the National Association of Regulatory Utility Commissioners (NARUC), the National Association of Pipeline Safety Representatives (NAPSR), and OPS.

The PPDC database is expected to improve the knowledge base of gas utility operators and regulators and is intended to help reveal any failure trends associated with older plastic piping materials. The PPDC's mission is "to develop and maintain a voluntary data collection process that supports the analysis of the frequency and causes of in-service plastic piping material failures." It provides an opportunity for government and industry to work together to evaluate the extent of plastic pipe performance problems and to mitigate any risks to safety. The PPDC started gathering data in January 2001 from OPS and State pipeline safety agencies. For more information on the PPDC, go to the AGA web page ([www.aga.org](http://www.aga.org)), and enter "PPDC" in the keyword search.

## **II. Advisory Bulletin (ADB-02-7)**

To: Owners and Operators of Natural Gas Distribution Pipeline Systems

Subject: Notification of the Susceptibility to Premature Brittle-like Cracking of Older Plastic Pipe.

Advisory: In recent years, brittle-like cracking has been observed in some polyethylene pipes installed in gas service through the early 1980s. This brittle-like cracking (also known as slow crack growth) can substantially reduce the service life of polyethylene piping systems.

The susceptibility of some polyethylene pipes to brittle-like cracking is dependent on the resin, pipe processing, and service conditions. A number of studies have been conducted on older polyethylene

pipe. These studies have shown that some of these older polyethylene pipes are more susceptible to brittle-like cracking than current materials. These older polyethylene pipe materials include the following:

- Century Utility Products, Inc. products.
- Low-ductile inner wall “Aldyl A” piping manufactured by Dupont Company before 1973.
- Polyethylene gas pipe designated PE 3306. (As a result of poor performance this designation was removed from ASTM D-2513.)

The environmental, installation, and service conditions under which the piping is used are factors that could lead to premature brittle-like cracking of these older materials. These conditions include, but are not limited to:

- Inadequate support and backfill during installation
- Rock impingement
- Shear/bending stresses due to differential settlement resulting from factors such as:
  - Excavation in close proximity to polyethylene piping
  - Directional drilling in close proximity to polyethylene piping
  - Frost heave
- Bending stresses due to pipe installations with bends exceeding recommended practices
- Damaging squeeze-off practices

Service temperatures and service pressures also influence the service life of polyethylene piping. Piping installed in areas with higher ground temperatures or operated under higher operating pressures will have a shorter life.

Gas system operators may experience an increase in failure rates with a susceptible material. A susceptible material may have leak-free performance for a number of years before brittle-like cracks occur. An increase in the occurrence of leaks will typically be the first indication of a brittle-like cracking problem. It is the responsibility of each pipeline operator to monitor the performance of their gas system. RSPA issues the following recommendations to aid operators in identifying and managing brittle-like cracking problems in polyethylene piping involving taking appropriate action, including replacement, to mitigate any risks to public safety.

Because systems without known susceptible materials may also experience brittle-like cracking problems, RSPA recommends that all operators implement the following practices for all polyethylene piping systems:

1. Review system records to determine if any known susceptible materials have been installed in the system. Both engineering and purchasing records should be reviewed. Based on the available records, identify the location of the susceptible materials. More frequent inspection and leak surveys should be performed on systems that have exhibited brittle-like cracking failures of known susceptible materials.



2. Establish a process to identify brittle-like cracking failures. Identification of failure types and site installation conditions can yield valuable information that can be used in predicting the performance of the system.
3. Use a consistent record format to collect data on system failures. The AGA Plastic Failure Report form (Appendix F of the AGA Plastic Pipe Manual) provides an example of a report for the collection of failure data.
4. Collect failure samples of polyethylene piping exhibiting brittle-like cracking. Evidence of brittle-like cracking may warrant laboratory testing. Although every failure may not warrant testing, collecting samples at the time of failure would provide the opportunity to conduct future testing should it be deemed necessary.
5. Whenever possible record the print line from any piping that has been involved in a failure. The print line information can be used to identify the resin, manufacturer and year of manufacture for plastic piping.
6. For systems where there is no record of the piping material, consider recording print line data when piping is excavated for other reasons. Recording the print line data can aid in establishing the type and extent of polyethylene piping used in the system.

(49 U.S.C. Chapter 601; 49 CFR 1.53)

Issued in Washington, DC on \_\_\_\_\_.

Stacey L. Gerard,

Associate Administrator for Pipeline Safety.